
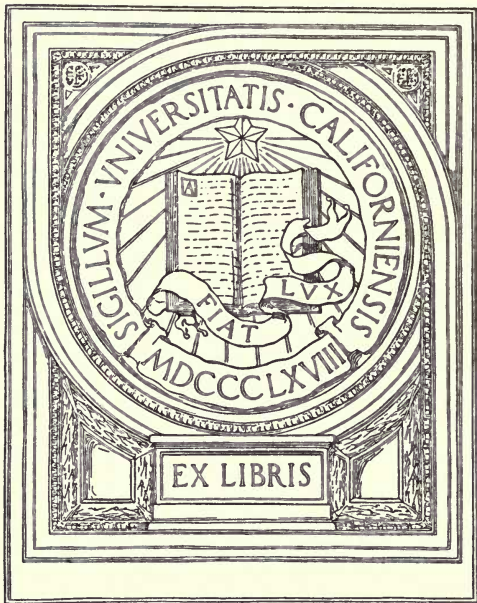


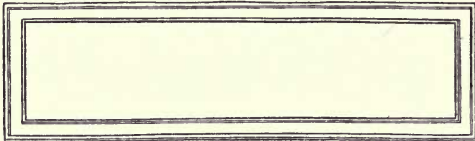
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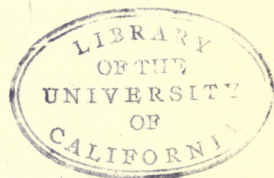
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The Selling of Copper

BY
H. J. STANDER



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THE SELLING OF COPPER

By H. J. STANDER

When a metal takes such marvelous leaps in its price as copper has been doing during the last several months, it draws the attention of people who otherwise are not at all interested in the production, working and selling of that particular metal. Just at the present time all mining men, mining engineers and others are watching the price of copper with very great interest.

Before anything can be done with regard to the selling of an ore, it is necessary to know its composition as accurately as possible. In the case of a copper ore, one must know not only the percentage of copper or copper sulphide present, but also the percentages of all the other materials, because some substances in the ore may bring a bonus, whereas one is penalized for other substances should they happen to be present in the ore. The amount of both the bonus and the penalty will depend upon the percentages in which such substances appear. The basis on which the price of the ore is estimated is the price of the refined metal at the time the valuation is made, as quoted by some principal market center, such as New York.

It is very important to know the contents of an ore in gold, silver, copper, lead and zinc, if some or all of these metals be present. The ore is also quantitatively analyzed for the following: silica, sulphur, iron, alumina and lime, and sometimes also for antimony, arsenic, magnesia and barium. It is in lead and copper ores especially that one must know within narrow limits the amounts, in both the ores and the flux, of the silica, lime, magnesia, sulphur, iron and alumina, in order to control smelting operations.

After the percentages of all these substances have been determined, and the composition of the ore has been decided and agreed upon by the parties interested, it becomes possible for them to agree upon the valuation of the ore, and this valuation, as stated above, is also based upon the price of the refined metal, as quoted by the market at the time the valuation is made.

To obtain the gross value of the ore, one gets the sum of the products obtained by multiplying the metal contents, in pounds for the base metals and in troy ounces for the precious metals, per avoirdupois ton

by the prevailing price of the refined metals. To obtain the net value of the ore, the total cost of mining it, together with the charge for treatment is deducted from the gross value. The cost of treatment is determined by considering the freight charges to the treatment plant, the milling or smelting charges, compensation charges for loss of metal during the process of treatment, penalties on undesirable substances in the ore, freight charges to the refinery, charges for refining the metal, and charges for the selling of the refined metal. It thus becomes necessary for the buyer and purchaser, before they can agree upon the valuation of the ore, to consider some or all of these items.

Considering the cost of capital invested, labor, power, repairs, depreciations, etc., it is possible to ascertain a basic smelting charge per ton of ore, reckoning also a certain sum per ton for furnace charge. It is upon such a basic smelting charge that the smelting rates are based. Should an ore contain an excess of silica, a penalty is imposed based upon the amount of silica in excess of that which the furnace charge ought to contain, because, in order to take care of this excess amount of silica, the smelter has to provide an iron or lime flux. The amount of the penalty will then simply be the cost of this flux. Now very often the ore itself contains an excess of iron, and by an excess of iron is meant an amount of iron in the ore more than is required for the ideal furnace charge, and in such a case the excess quantity of iron may be sufficient to flux the excess amount of silica. In other words, the excess amounts of silica and iron just neutralize each other in the furnace charge, with the result that no penalty need be imposed. From this one will see that the mining of silicious and ferruginous ores need not necessarily be detrimental. This basis of determining smelter charges is known as the "neutral schedule."

It is easy to see that theoretically the smelter does not gain anything by using the 'neutral schedule,' in the determination of the smelting charges, yet it very often means some profit to them. It is assumed that in the ideal furnace charge one part of silica fluxes there is one part of iron or lime, and this is true in the case of copper smelting. But a bonus paid on a unit, or 1% per ton, of excess iron is about 5 to 10 cents, whereas the penalty on excess silica is about 10 to 15 cents. Thus the smelter can never lose when it uses the neutral schedule system, because if the excess is silica, it is multiplied by the penalty per unit, and this product is added to the smelting charges; whereas, should there be an excess of iron, it is multiplied by the bonus per unit and subtracted from the smelting charge. This is one way of determining the final smelting charge. Some smelters have quite a different system. After having obtained the amounts of excess silica and iron

respectively, they determine how much of either silica or iron there will be in excess, if every one part of the iron can be neutralized by one part of the excess silica present. Supposing that the excess amounts of silica and iron in the ore are in the ratio of 11 parts of silica to 10 parts of iron, the 10 parts of iron can be fluxed with 10 parts of silica, and the final excess of silica will then be 1 part. The seller is then penalized for this one part of excess of silica. Since the penalty on silica amounts to about 10 cents per unit, and the bonus on iron only to 5 cents, it is quite clear that such a method of calculating excess favors the silicious ore more than does the first system described above.

There are certain districts in which ferruginous ores are more common than siliceous ores, and in such cases the penalty may be placed on the iron, and the bonus given to the silica. Where silicious ores are in great demand, it is usually customary to base the smelting charge on the so-called "flat schedule." By a "flat schedule" is meant a fixed charge, paying no attention to the composition of the ore, as does the neutral schedule. The flat schedule is really based on an empirical value of the cost of smelting that particular ore, and since the percentage of the metal is never absolutely constant in an ore, the cost of smelting such an ore will vary with the amount of metal in it—in other words, the flat schedule is, in most cases, on a sliding scale. Thus, in the flat schedule the only thing considered is the percentage of metal in the ore, whereas the neutral schedule considers, besides this, the composition of the ore.

The smelting charges on high-grade ores are higher than those on the low-grade ores, when one considers the relative tonnage of each class. The smelting charges on low-grade ores are not much over the actual cost—in fact, in some cases, they are below actual cost. If, now, an average smelting rate had to be adopted, it would make it almost impossible to work very low-grade ores, and thus the sliding scale is the customary system used, because in such a case a low-grade ore can be worked much more profitably than when a melting charge, irrespective of the metal content, be imposed. One must, however, not forget that an increase in the metal content, means less gangue to be fluxed and the smelting operation then becomes cheaper. Thus, the smelter charges will decrease as the metal content increases, in the case of copper and lead ores, whereas this is not true to the same extent when the value of the ore is largely in gold.

In copper ores, the amount of copper present in the ore is usually determined by what is known as "wet analysis." Such a wet analysis can be carried out either electrolytically or volumetrically, and there are two volumetric methods, the iodide and the cyanide method. It is

also possible, however, to obtain the percentage of copper in an ore by a fire assay, but as the results are usually below the correct values, this method is not at all in general use. The smelter pays for the actual "yield" of copper in an ore, and this actual "yield" is usually the figure given by the wet analysis, less from 0.75 to 1.5%.

Thus, if an ore should contain copper less than, say 1%, the owner cannot expect the smelter to pay him for the copper in his ore. It is customary, then, to state in a contract on what basis the content of the metal shall be decided. Thus a contract may read that the percentage of copper in the ore shall be determined by the wet analysis less 1%. This would mean that if both parties agreed that the wet analysis on a given shipment of ore figured out to be 8.5% copper, the smelter will pay for only 7.5% copper in the ore, and 1% representing the loss in smelting as agreed upon in the contract.

The New York quotations on copper are always made on three types of copper. These types or bands are as follows:

- I. Electrolytic copper—ingots and wire bars.
- II. Electrolytic copper, not in the form of ingots or wire bars, but as cathods. This is simply the copper as deposited in its original form, without being melted afterwards.
- III. Casting copper, which is only reasonably pure.

Cathode copper is usually quoted at about 0.1 cent and casting copper at 0.2 cent less than wire bars. The smelter's deduction for copper from the New York quotations are as follows, in the case of lead ores containing copper:

- From 1.5 to 5% copper—6 cents off casting copper quotation.
 - From 5 to 10% copper—5 cents off casting copper quotation.
 - More than 10% copper—4 cents off casting copper quotation.
- Whereas the figures for the copper contained in copper ores are:
- From 1.5 to 5% copper—5 cents off electrolytic copper ore.
 - From 5 to 10% copper—4½ cents off electrolytic copper ore.
 - From 10 to 20% copper—4 cents off electrolytic copper ore.
 - From 20 to 30% copper—3½ cents off electrolytic copper ore.
 - Over 30% copper—3 cents off electrolytic copper ore.

In order to recover the copper in a lead ore, it is necessary to treat the matte formed in the lead blast furnace, because as the lead ore is smelted the heavy metal, lead, collects at the bottom and carries with it the gold and silver and a little copper; while a matte is formed on top of this and contains chiefly iron sulphide, copper and perhaps a small amount of gold and silver. Then there is, of course, the slag on top of the matte; but the point is that this matte, formed in the smelting of a lead ore, is different from that produced in copper smelting,

in that it contains some lead. To treat the matte from a lead furnace to recover the copper is more expensive than the cost of recovering the copper in the matte from a copper smelter. It is for this reason that the figures given above, dealing with the smelter deductions from market prices for copper in the case of a lead ore containing copper are higher than those given for a copper ore.

PENALTIES

The penalties with regard to silica and iron in copper ore have already been mentioned, and the other materials in a copper ore on which a penalty is imposed are zinc, arsenic and antimony.

In the copper smelter one cannot recover the zinc, as it passes into the fume and fine dust, and into the slag. The slag can contain as much as 10% zinc without any considerable detriment, but when there is more than 10% zinc in a slag, it becomes viscid and causes trouble. Zinc is also detrimental to the furnace itself, in that it forms incrustations in the furnace; and a further trouble brought about by the presence of zinc in a copper ore is that the zinc in volatilizing will carry some of the metal with it, as it causes volatilization of the copper also. The penalty on zinc is about 30 to 50 cents per unit above 10% zinc present. This means about 30 to 50 cents for every 20 pounds of zinc, about 200 pounds in a ton of ore. This is a very heavy penalty and encourages the separating out of the zinc in the mill, because it then becomes possible not only to escape paying the zinc penalty to the smelter, but very often to make a zinc product which can be sent to a zinc smelter.

Arsenic is occasionally penalized in copper smelting, and this also applies to antimony. Both arsenic and antimony will form, together with the copper and iron, a so-called "speiss." This speiss is a very undesirable by-product in that it is very costly to treat for the recovery of the metals contained in it. A penalty is thus usually imposed on an arsenic and antimony content greater than 1%.

The main markets for copper are New York, London and Hamburg. All the big nations, with the exception of Russia, have agreed that no duty shall be imposed on either the importation or the exportation of copper, so that the copper market is the same throughout the world. The few selling agencies in New York handle almost all the copper produced, while there are only a few of the producers that sell their copper direct.

There are four kinds of copper sold; they are:

I. Lake copper, i. e., that coming from the Lake Superior district.

II Electrolytic copper. This is the refined copper, and these

copper refineries usually refine the copper coming from the west.

III. Pig copper.

IV. Casting copper.

These last two kinds of copper are somewhat impure, as the pig copper does not contain enough silver to pay for its refining and the casting copper is made from old scrap copper. As has been mentioned before, there are two kinds of electrolytic copper, the bars and the cathode, but the cathode copper is somewhat uncommon at the present time. Lake copper still has a premium of about $\frac{1}{4}$ cent over electrolytic copper, although the electrolytic copper is very often better in its electrical conductivity than the Lake copper, but this premium is perhaps only a result of the reputation the Lake copper has had in the past.

THE FORMS IN WHICH COPPER IS MARKETED

- I. Pigs, similar to the pigs of cast iron, weighing 100 pounds each.
- II. Rectangular cakes of different sizes.
- III. Ingots, like the pigs, but partly divided into two or three sections, so as to make it easy to break it for introduction into crucibles used for melting.
- IV. Ingot bars, partly divided into 3 to 5 parts. These bars weigh from 60 to 90 pounds.
- V. Wire bars, tapering towards one end.

"OPEN SCHEDULES" FOR COPPER-LEAD-GOLD-SILVER ORES

The schedules given below are in force in the western sections of the United States.

1. Lead-copper ores, containing gold and silver. *Neutral schedule.*
 - Gold, \$19.50 per ounce of 0.05 ounce or over per ton.
 - Silver, 95% of contents, date of assay.
 - Lead (dry)—Prices are based on \$4 quotation.
 - Copper—For dry copper, which is 1.5% off wet, 6 cents off per pound on Western Union quotation for casting copper.
 - Zinc—10% allowed, and 50 cents penalty per unit, in excess of this.
 - Silica—Penalty, 10 cents per unit; iron bonus, 10 cents per unit.
11. Copper ores containing gold and silver. *Neutral schedule.*
 - Gold—\$19 per ounce if product contains 0.03 ounce or over per ton.
 - Silver—95% of contents at New York quotation, date of assay.
 - Copper—As per wet assay, less 1% of unit, at the price for

Cathode copper quoted in the *Engineering & Mining Journal*, issue of week previous to date of receipt, less $2\frac{1}{2}$ cents per pound. (This price changes according to supply and demand conditions.)

Iron—Paid for at 10 cents per unit.

CHARGES

Insoluble—10 cents penalty per unit.

Zinc—10 per cent allowed free; excess at 25 cents per unit.

Speiss—10 per cent allowed free; excess at 25 cents per unit.

Treatment charge—\$3 per ton.

The above prices are an average but vary considerably under local conditions. For instance, many localities may have an excess of silicious ores which will cause an increased bonus to be paid for iron ores, and vice versa, districts supplying large quantities of ores heavy in iron may have a larger percentage of silica without penalty.

The ascertaining of a correct smelter charge takes so many factors into consideration that it is generally misunderstood by the seller of ore; he ordinarily believes that he should merely be paid for the copper, gold and silver and whatever other metals it contains, not realizing that in smelting operation it is impossible to obtain all of the copper; that in selling the metallic copper the full quoted market price is not obtained; that the copper produced at the smelter is not purified copper ready for the market; that there are many things in the ore which cause additional flux, which contain no value to be purchased and handled.

In order to successfully operate a smelter, the mixtures going to the furnaces cannot be varied from hour to hour or even from day to day; hence to get the proper mixture of ores, the smelters desire large and regular shipments. A small shipment is as much work for the assaying and general charges as a large shipment; hence it is not unreasonable to expect that the costs of smelting will be greater for small shipments. Small shipments influence the mixtures and often upset considerable routine operation. In the case of the excessive supply, and the working of the smelters to their fullest capacity, it is often true that smelters will refuse to accept small, irregular shipments.

Another point generally misunderstood is the fact that while the smelter is paying for ores received, based on prices upon the day or week of the purchase, they do not receive the payment for the metal produced for some 90 or 100 days—hence fluctuations on the market must play a very considerable part in the fixing of smelter prices.

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